WHAT IS CLAIMED IS:

1. An ozonized carbon nanotube wherein about 3% to 30% of the sidewall carbon atoms have a primary ozonide attached.

2. An ozonized carbon nanotube of Claim 1 wherein the range of the quantity of sidewall carbon atoms that have a primary ozonide attached has a lower boundary of approximately 5%, 8%, 10% or 12 %.

3. An ozonized carbon nanotube of Claim 1 wherein the range of the quantity of sidewall carbon atoms that have a primary ozonide attached has an upper boundary of approximately 25%, 20% or 16 %.

4. A method of ozonizing the sidewalls of carbon nanotubes, the method comprising:

exposing a carbon nanotube dispersion to an ozone/oxygen mixture to form a plurality of ozonized carbon nanotubes,

wherein the exposure of the carbon nanotube dispersion to the ozone/oxygen mixture takes place at a temperature of from about - 95 °C to about - 55 °C, and wherein the ozone is added to the sidewalls by 1,3-dipolar cycloaddition to attach primary ozonides on the sidewalls of the nanotubes.

5. A carbon nanotube wherein about 1 to 16% of the carbon atoms on the sidewall of the nanotube have an attached oxygen moiety.

6. A carbon nanotube of Claim 5 wherein the range of the quantity of sidewall carbon atoms that have an oxygen moiety attached has a lower boundary of approximately 3%, 5 or 8%.

7. A carbon nanotube of Claim 5 wherein the range of the quantity of sidewall carbon atoms that have an oxygen moiety attached has an upper boundary of approximately 10%, 12% or 15 %.

8. A carbon nanotube as in Claim 5, wherein the attached oxygen moieties comprise a high degree of carboxylic and/or esteric moieties.

9. A carbon nanotube as in Claim 8 wherein at least about forty percent, at least about fifty percent, or at least about sixty percent of the oxygen moieties are carboxylic and/or esteric moieties.

10. A carbon nanotube as in Claim 5, wherein the oxygen moieties comprise a high degree of ketonic and/or aldehydic moieties.

11. A carbon nanotube as in Claim 10 wherein at least about thirty percent, at least about forty percent, or at least about fifty percent of the oxygen moieties are ketonic and/or aldehydic moieties.

12. A carbon nanotube as in Claim 5, wherein the oxygen moieties comprise a high degree of alcoholic and/or ether moieties.

13. A carbon nanotube as in Claim 12 wherein at least about twenty percent, at least about thirty percent, or at least about forty percent of the oxygen moieties are alcoholic and/or ether moieties.

14. A method of functionalizing the sidewalls of a plurality of carbon nanotubes with oxygen moieties, the method comprising:

exposing a carbon nanotube dispersion to an ozone/oxygen mixture to form a plurality of ozonized carbon nanotubes; and

contacting the plurality of ozonized carbon nanotubes with a cleaving agent to form a plurality of sidewall-functionalized carbon nanotubes.

15. A method as in Claim 14 wherein the exposure of the carbon nanotube dispersion to the ozone/oxygen mixture takes place at a temperature of from about -95°C to about - 55°C.

16. A method as in Claim 14 wherein the ozone/oxygen mixture is in the solution phase.

17. A method as in Claim 14 wherein the ozone/oxygen mixture is in the gas phase.

18. A method as in Claim 14 wherein the ozone/oxygen mixture comprises 2% to 20 % ozone by weight.

19. A method as in Claim 14 wherein the contact of the plurality of ozonized carbon nanotubes with cleaving agents takes place at a temperature of from about -95°C to about - 65°C.

20. A method as in Claim 14 further comprising quenching the sidewall functionalized carbon nanotubes with organic solvents or acids.

21. A method as in Claim 14 wherein the cleaving agent is an organic peroxide, an inorganic peroxide, silver oxide or zinc dust.

22. A method as in Claim 14 wherein the cleaving agent is hydrogen peroxide.

23. A method as in Claim 22 wherein the hydrogen peroxide is in an aqueous solution wherein the solution comprises 30-70 wt% of hydrogen peroxide.

24. A method as in Claim 22 wherein the amount by weight of the aqueous hydrogen peroxide solution to the amount by weight of the carbon nanotube dispersion are in a ratio from about 1 : 50 to about 1 : 5.

25. A method as in Claim 22 wherein the hydrogen peroxide solution in contact with the carbon nanotube dispersion is heated to a temperature of about -60 °C to about 95 °C.

26. A method as in Claim 25 wherein the aqueous organic peroxide solution in contact with the carbon nanotube dispersion is heated to a temperature of about 65 °C to about 75 °C.

27. A method as in Claim 4 wherein the cleaving agent is selected from the group consisting of dimethyl sulfide, piperidine, triethylamine and 3'-thiodipropionic acid and it salts.

28. A method as in Claim 27 wherein the amount by weight of the cleaving agent to the amount by weight of the carbon nanotube dispersion are in a ratio from about 10 : 1 to about 100 : 1.

29. A method as in Claim 14 wherein the cleaving agent is a salt of borohydride or lithium aluminum hydride.

30. A method as in Claim 29 wherein the salt of borohydride is selected from the group consisting of sodium borohydride, potassium borohydride, lithium borohydride, tetraethylammonium borohydride, tetrabutylammonium borohydride, and sodium triacetoxyborohydride.

31. The method according to Claim 30 wherein the amount by weight of the borohydride salt or lithium aluminum hydride, to the amount by weight of the carbon nanotube dispersion are in a ratio from about 2 : 1 to about 50 : 1.

32. A method according to Claim 14 further comprising converting the oxygen moieties to other functional moieties, such as amides, thiols, acid halides, anhydrides, lactams, imides, lactones, nitriles, and mixtures thereof.

33. A carbon nanotube comprising oxygen moieties on its sidewall wherein the nanotube comprises less than about 2 wt.% of iron.

34. A carbon nanotube of Claim 33 comprising oxygen moieties on its sidewall wherein the nanotube comprises less than about 1.5 wt.% of iron, less than about 1.25 wt.% of iron, less than about 0.5 wt.% of iron, or less than about 0.1 wt.% of iron.

35. A method of purifying a plurality of carbon nanotubes, the method comprising:

exposing a carbon nanotube dispersion to an ozone/oxygen mixture to form a plurality of ozonized carbon nanotubes,

contacting the plurality of ozonized carbon nanotubes with a cleaving agent, and

contacting the plurality of functionalized carbon nanotubes with acid, whereby the plurality of carbon nanotubes is purified.

36. A carbon nanotube wherein about 1 to 16% of the carbon atoms on the sidewall of the nanotube have attached functional moieties selected from the group consisting of amides, thiols, acid halides, anhydrides, lactams, imides, lactones, nitriles and mixtures thereof.

37. A carbon nanotube of Claim 36 wherein the range of the quantity of sidewall carbon atoms that have a functional moiety attached has a lower boundary of approximately 3%, 5 or 8%.

38. A carbon nanotube of Claim 36 wherein the range of the quantity of sidewall carbon atoms that have a functional moiety attached has an upper boundary of approximately 10%, 12% or 15 %.

39. A method of providing single carbon nanotubes and carbon nanotube bundles with a selected diameter, the method comprising:

exposing a carbon nanotube dispersion to an ozone/oxygen mixture to form a plurality of ozonized carbon nanotubes,

wherein the exposure of the carbon nanotube dispersion to the ozone/oxygen mixture takes place at a temperature of from about - 95 °C to about - 55 °C, and wherein the ozone is added to the sidewalls by 1,3-dipolar cycloaddition to form oxygenated moieties on the sidewalls of the nanotubes,

retrieving the single carbon nanotubes and carbon nanotube bundles with a selected diameter from the dispersion.

40. A method of functionalizing the sidewalls of carbon nanotubes predominately with carboxylic and/or esteric moieties, the method comprising:

contacting a plurality of ozonized carbon nanotubes, which plurality comprises nanotubes with primary ozonides on their sidewalls, with a hydrogen peroxide solution, an organic peroxide, an inorganic peroxide, silver oxide or zinc dust, thereby functionalizing the sidewalls of the carbon nanotubes.

41. A method of functionalizing the sidewalls of carbon nanotubes predominately with ketonic and/or aldehydic moieties, the method comprising:

contacting a plurality of ozonized carbon nanotubes, which plurality comprises nanotubes with primary ozonides on their sidewalls, with dimethyl sulfide, piperidine, triethylamine or 3'-thiodipropionic acid,
thereby functionalizing the sidewalls of the carbon nanotubes.

42. A method of functionalizing the sidewalls of carbon nanotubes predominately with alcoholic and/or ether moieties, the method comprising:

contacting a plurality of ozonized carbon nanotubes, which plurality comprises nanotubes with primary ozonides on their sidewalls, with sodium borohydride, potassium borohydride, lithium borohydride, tetraethylammonium borohydride, tetrabutylammonium borohydride, or sodium triacetoxyborohydride
thereby functionalizing the sidewalls of the carbon nanotubes.